

EU-Projects on Automation of Road Transport and the iMobility Forum: Joint Systems Perspective

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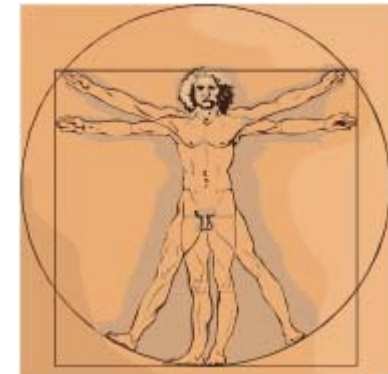


Knowledge for Tomorrow

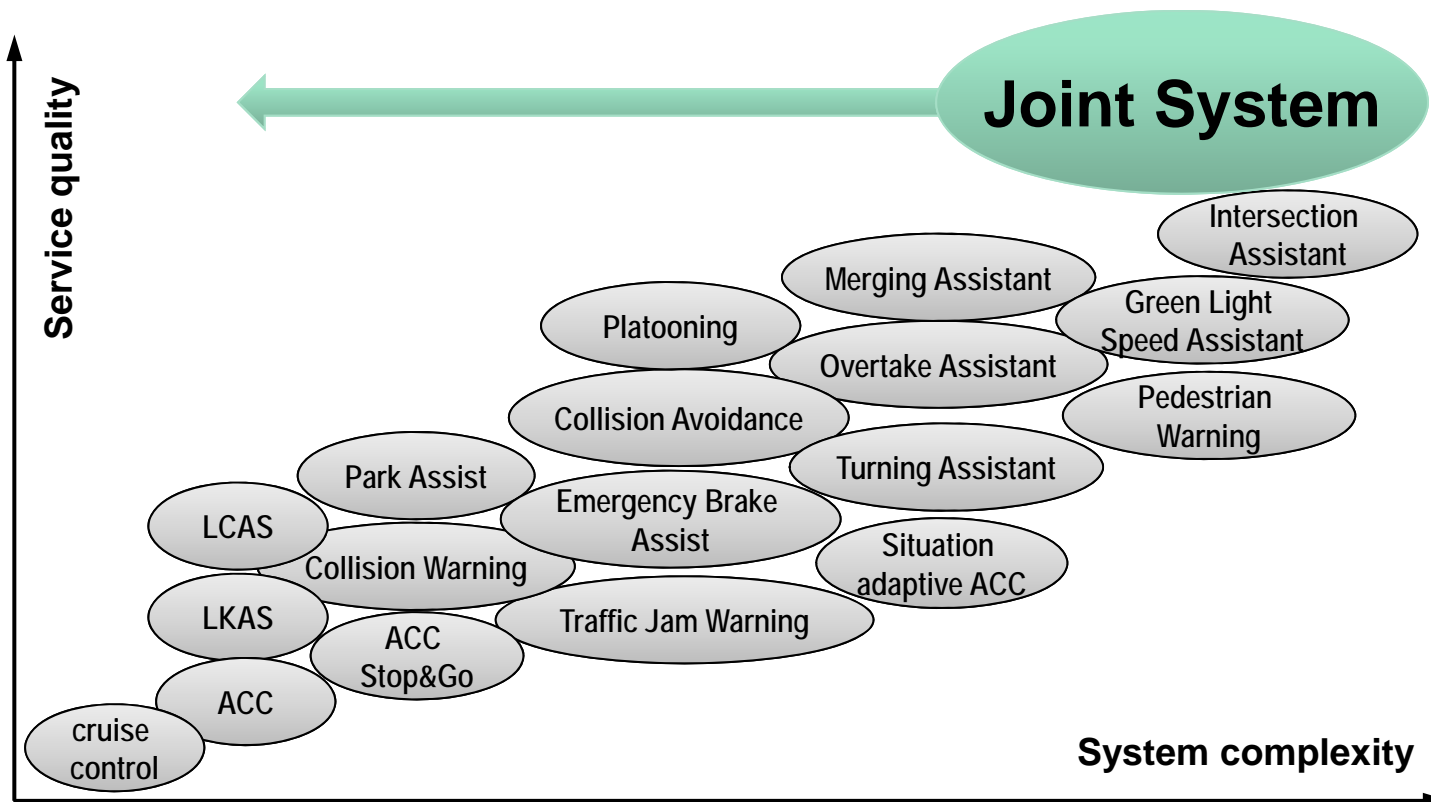


Overview

- Motivation for **Joint Driver-Automation System Design**
- Joint System components addressed in **EU-Projects and iMobility Forum**
- **Application examples** for highly automated road transport systems



Motivation for Joint System Design



- Raising number of different ADAS used in parallel
- Raising complexity of particular ADAS used in parallel



Toward Joint Human-Machine Systems Design

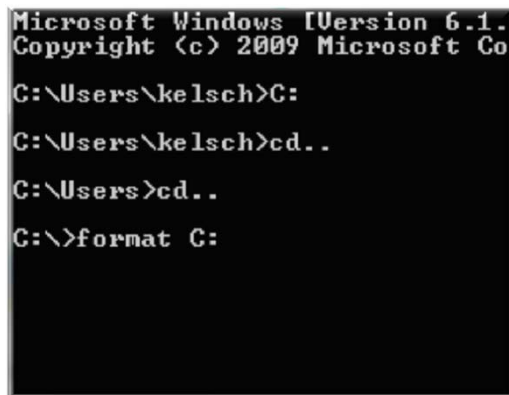
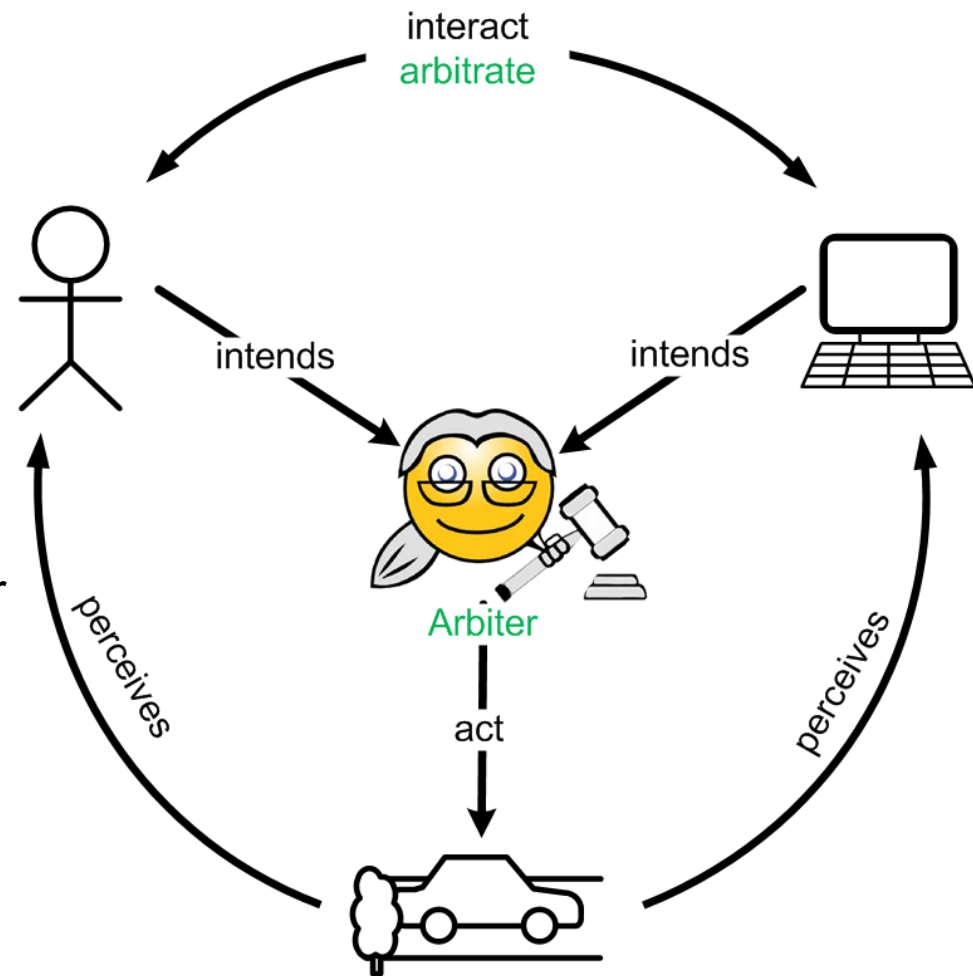


Diagram concept: Denis Javaux



Joint Driver-Automation System: Elements

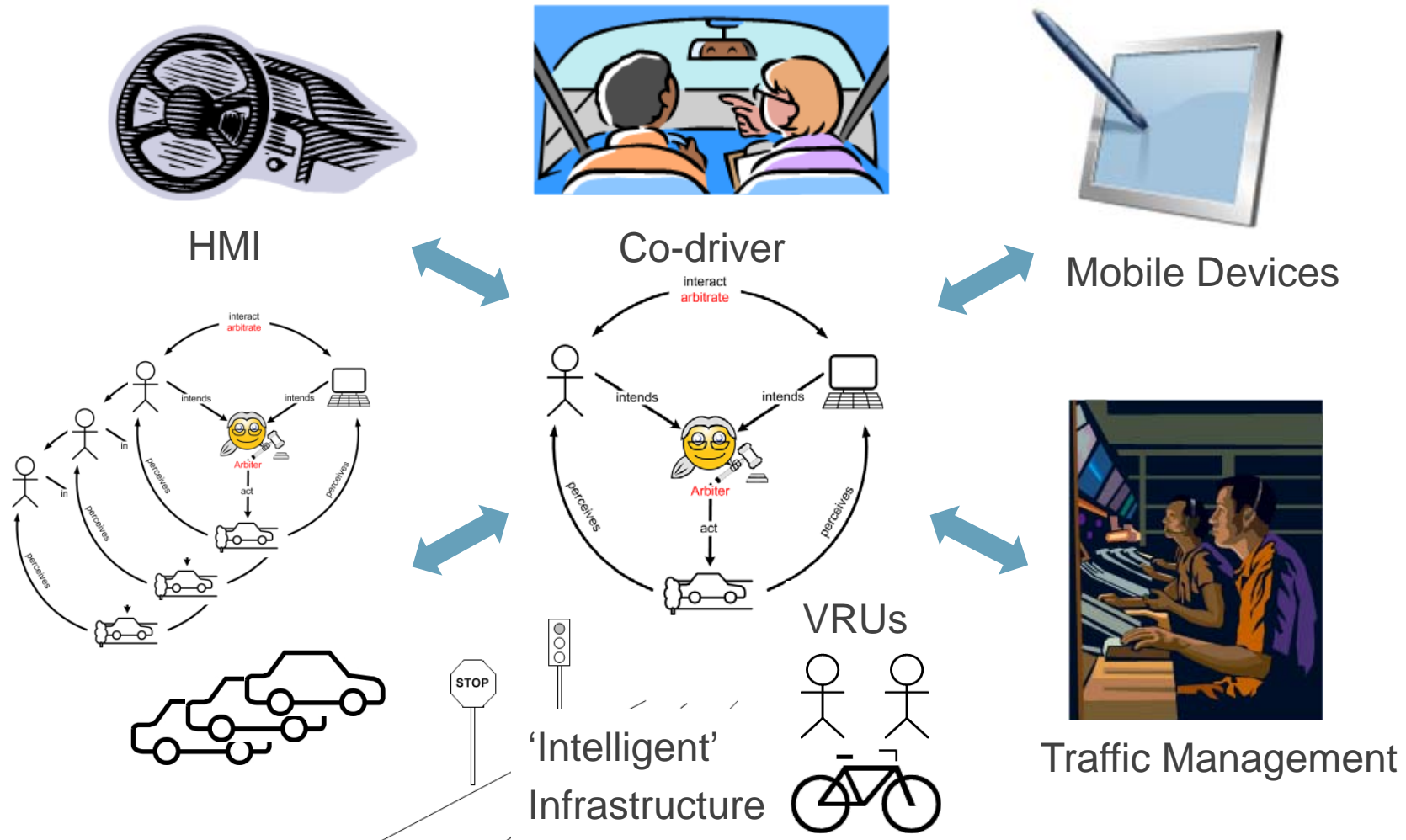
- Simplified **human** perception-action model
- **Machine** as a **cognitive agent***
- Human and machine **interacts** with each other
- Human and machine **compete** for vehicle control (shared control)
- **Arbitration** using
 - self-organization
 - role, task, control allocation



(*) Hollnagel & Woods, 1983



Joint Driver-Automation System: Elements



picture sources: <http://office.microsoft.com>



Human Factors Subgroup

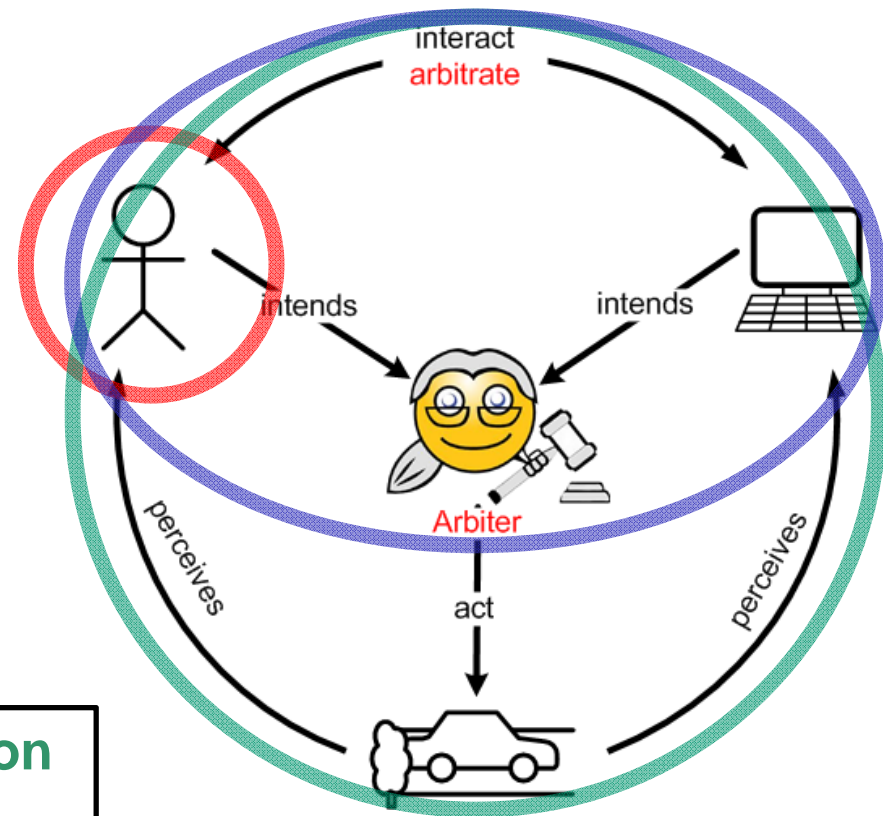
- Supported by EU commission & ERTICO (Brussels)
- DLR, TRL, ITS LEEDS, ICCS, IFSTTAR, UNIROMA, VEDECOM, TU EINDHOVEN, UNI CHALMERS, TU DELFT, EUCAR, VALEO, HIT
- **Human Factors in Highly Automated Road Transport**
- Automation effects on driver & other traffic participants (e.g. VRUs)
- HF related Joint System design issues
 - System distribution vs. system integration (e.g. connectivity effects)
 - **Controllability** (e.g. automation level transitions)
 - **Observability** (e.g. joint HMI concepts)
 - **Usability**
- HF related **roadmaps & recommendations** for the EU commission



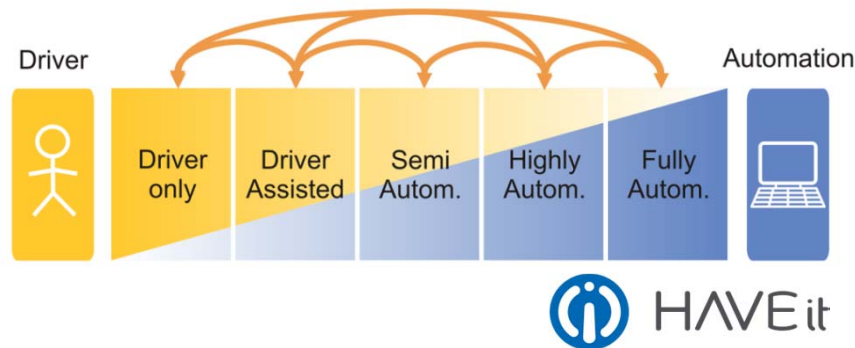
Joint Driver-Automation System: Taxonomy

- **Human Factors** is about human related system **problems**
- **Human Factors** is about human related system **solutions** as well
- **Interaction Design**
 - uses Human Factors knowledge
 - technical requirements meet Human Factors

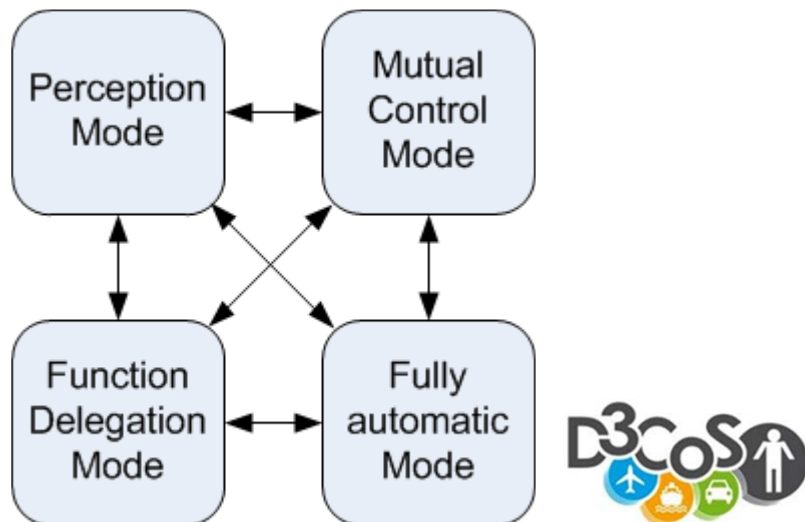
Generic **problem** + generic **solution**
= **Design Pattern**



Joint Driver-Automation System: Design Patterns



- **Automation Levels*** and transitions
 - **Problem** of correct human-machine **control distribution**
 - **Quantitative solution**
 - How much automation is there?




- **Cooperation Modes****
 - **Problem** of correct human-machine **task allocation**
 - **Qualitative solution**
 - Who does what and how?
- Both perspectives are **compatible** to each other***

(*) Parasuraman et al. 2000, (**) Hoc 2001, (***) EU-Project D3CoS D3-03



Joint Driver-Automation System in EU-Projects


- Joint System
- Automation Levels
- Transitions...



HAVE it
Highly automated vehicles for intelligent transport

The future of driving.


**Deliverable D61.1
Final Report**

 <p>ARTEMIS</p>	<p>D3CoS Designing Dynamic Distributed Co-operative Human-Machine Systems</p>	
<p>D3-03 Reference Designs and Design Patterns for Cooperation & DCoS State Inference and Adaptation</p>		

- Design patterns for cooperation
- Cooperation modes
- Methods & Tools...

- Inform/Warn/Intervene strategies
- Joint HMI Concepts
- Arbitration...



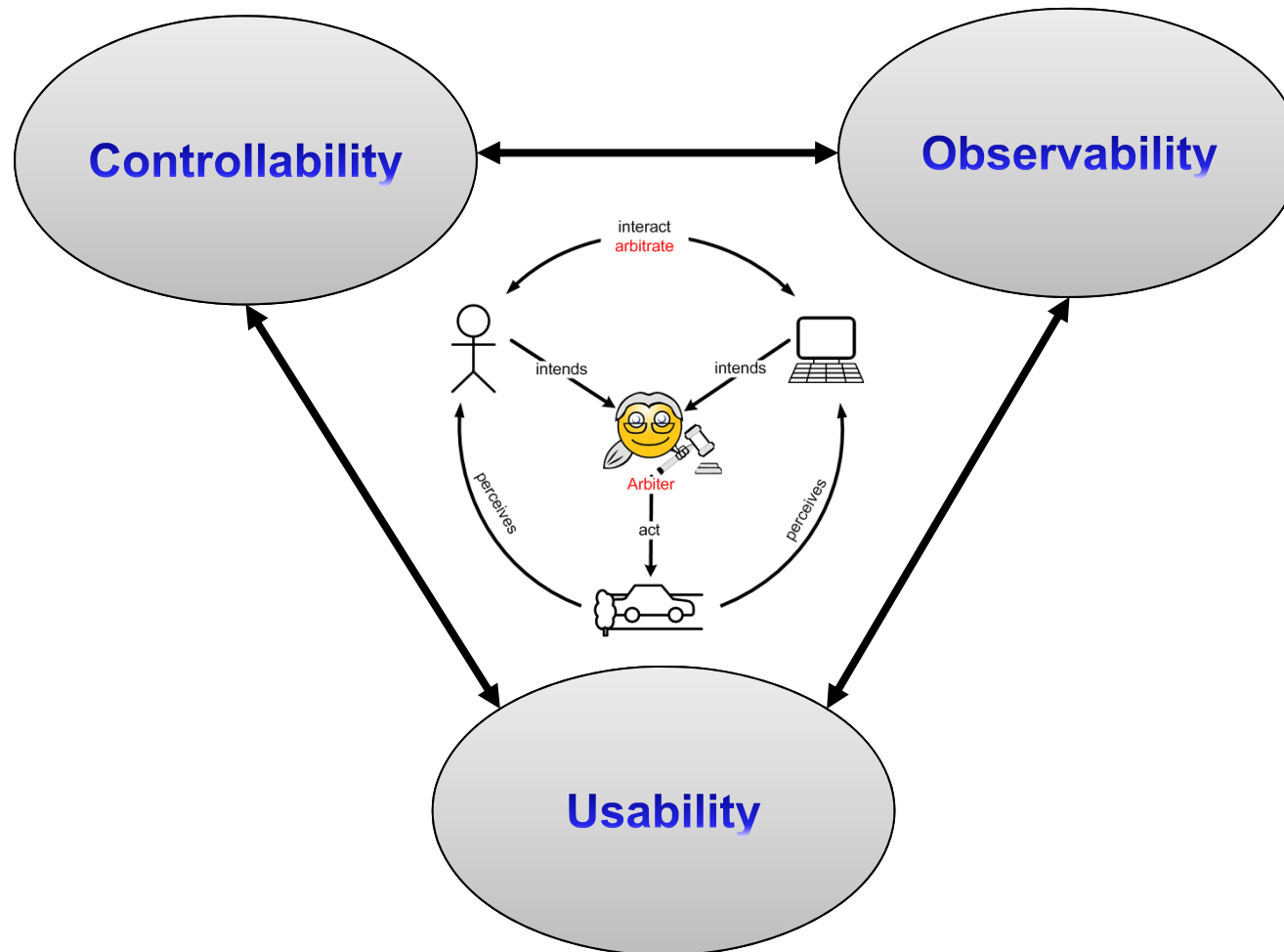
interactive 

Accident avoidance by active intervention for Intelligent Vehicles

Deliverable D3.2 | IWI Strategies | Executive Summary

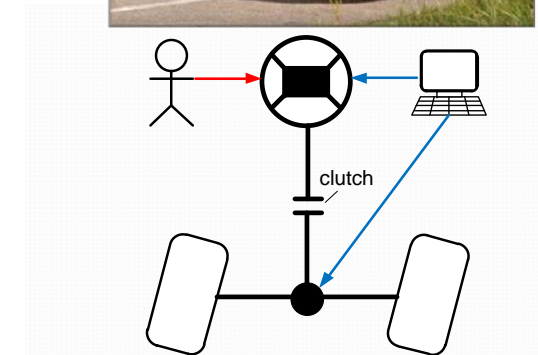


Joint Driver-Automation System Design Aspects



Join System Controllability: Decoupling Concept

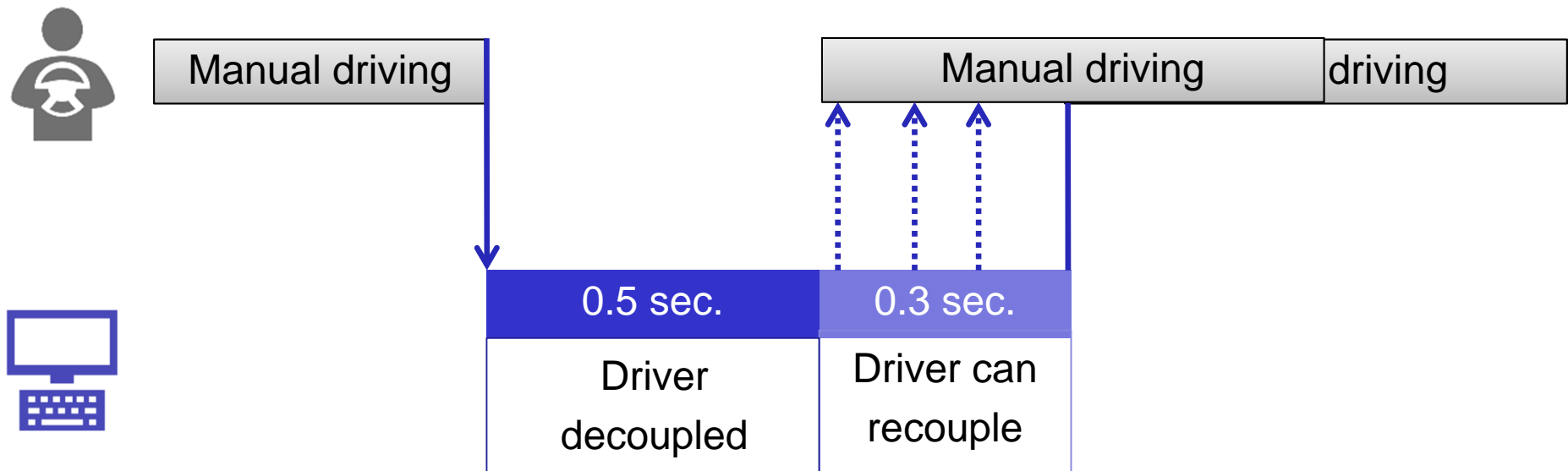
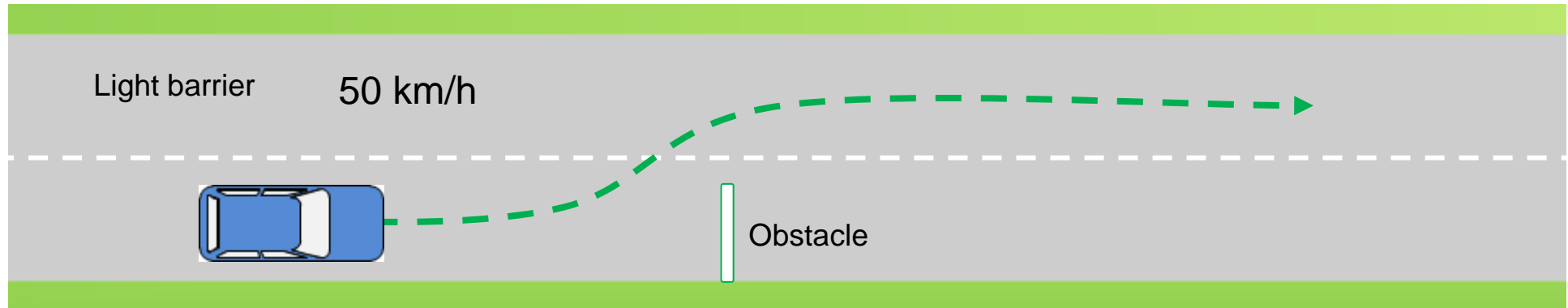
- Joint System performance in conditions
 - no automation
 - steering intervention (coupled)
 - steering intervention (decoupled)
 - **true vs. false** decoupling
- **FASCar II** from the German Aerospace center (DLR)
- equipped with **steer-by-wire** system
- Possibility to **decouple** the driver from vehicle control
- Obstacle covering half the lane
- Unfolds in 0.8 sec.



interactive 



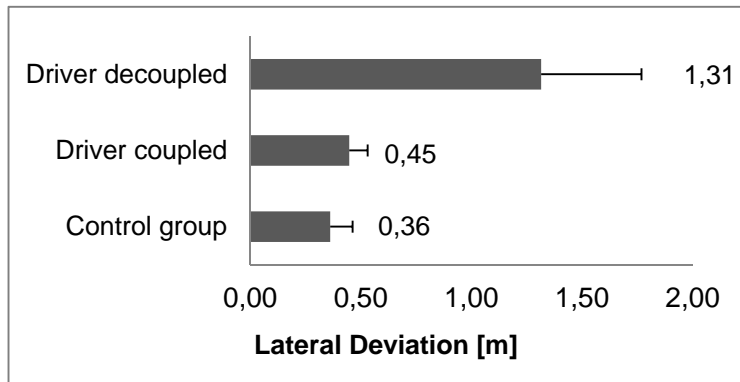
Controllability: Steering intervention (decoupled)



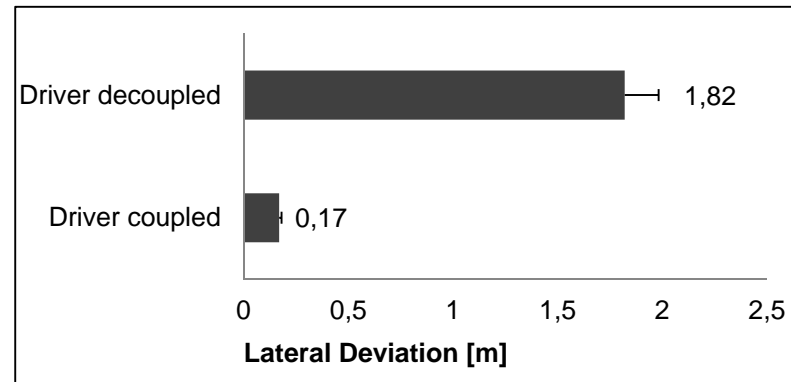


Controllability: Driver Decoupling Concept

‘true’ decoupling



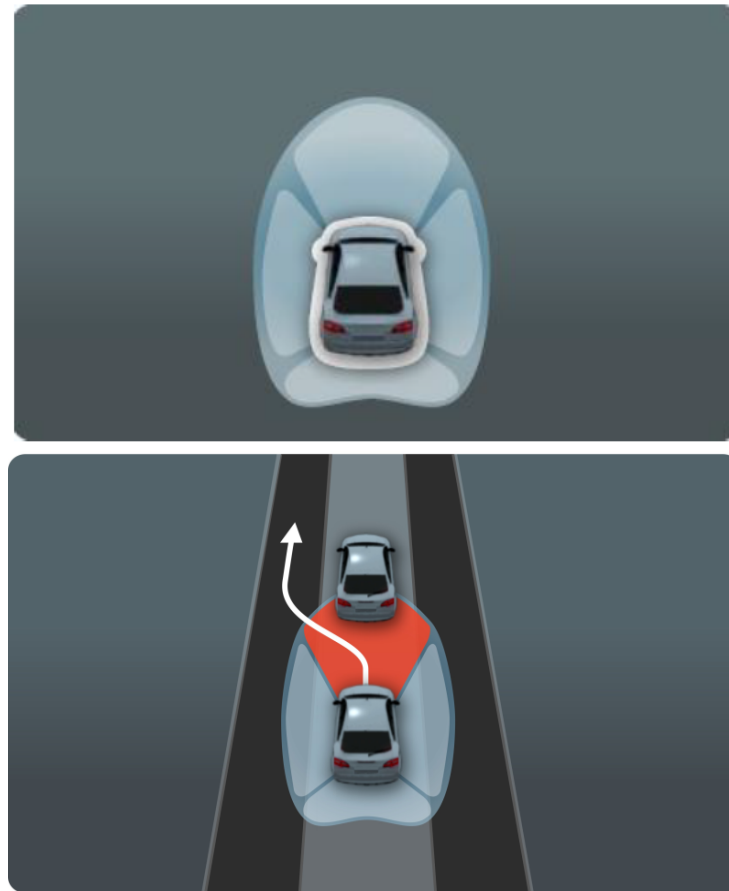
‘false’ decoupling



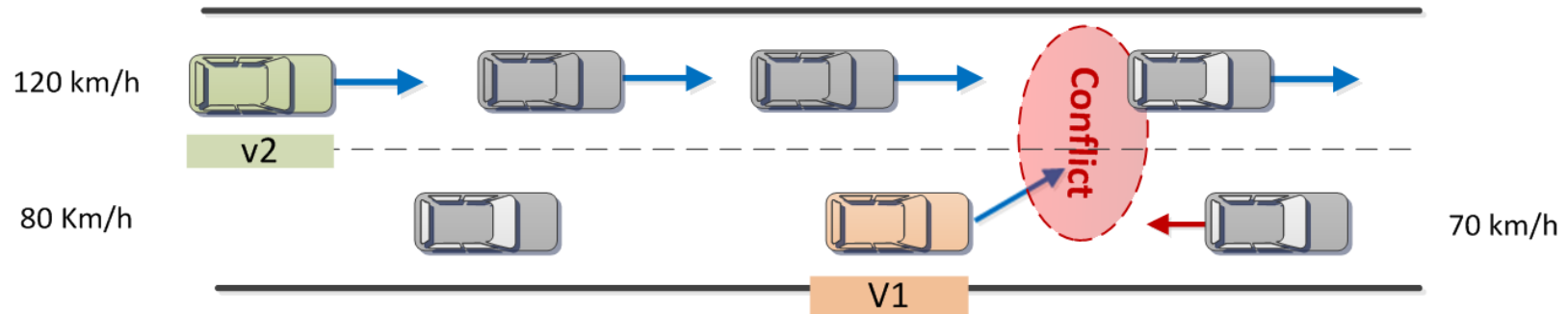
- Lateral deviation (50 km/h) in ‘true’ decoupling was significantly higher than in other conditions → **GOOD**
- ‘True’ decoupling seemed to be **well** controllable for the driver
- Lateral deviation (30 km/h) in ‘false’ decoupling was significantly higher than in other conditions → **BAD**
- ‘False’ decoupling seemed to be **badly** controllable for the driver



Joint System Observability: HMI Concepts

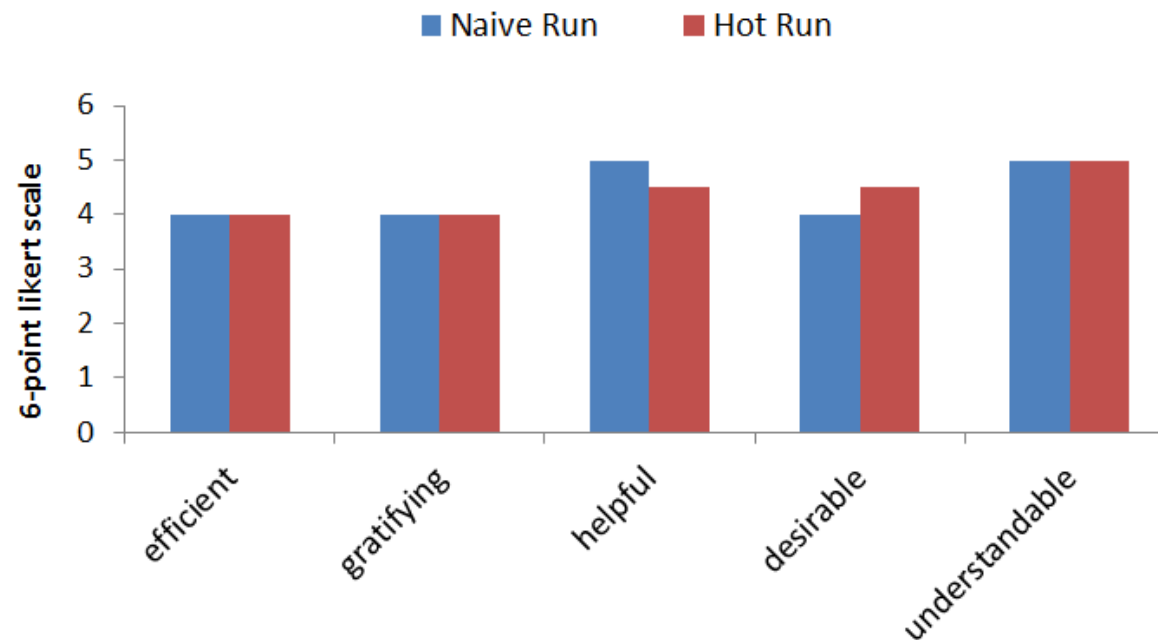


Joint System Observability: Cooperative Lane Change





Joint System Usability: Cooperative Lane Change Assist



- Well accepted system design
- Easy to understand



Our research focus in...

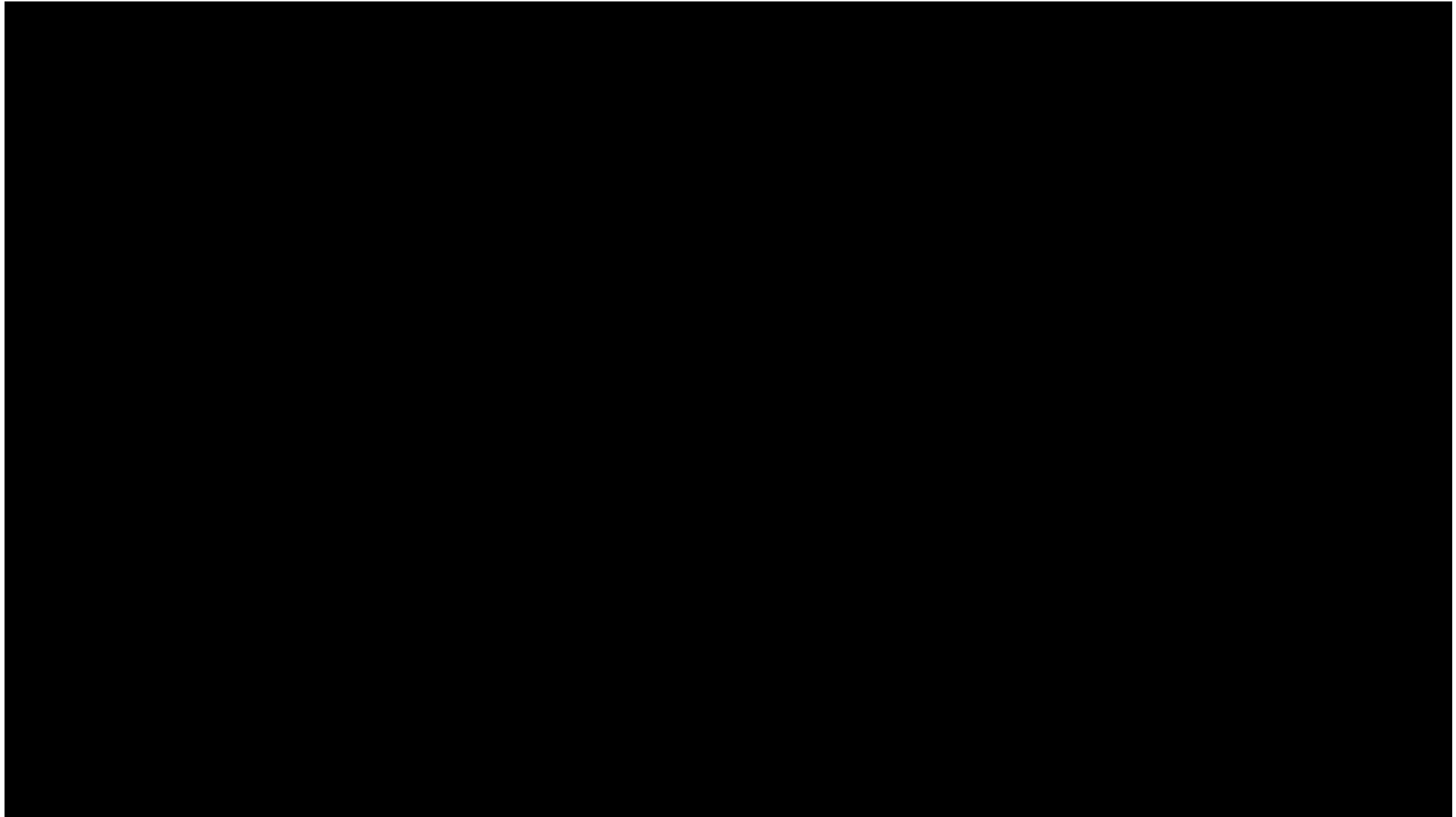
- Designing a Joint System
- Ambient display
 - visual, haptic & acoustic stimuli
- **Idea:**
 - Transporting information by using peripheral vision
 - Supporting / inhibiting drivers' actions by using affective design
- **Aim:** Improving performance in
 - primary driving tasks
 - automation mode transitions
 - in normal & emergency situations



Adapt^{!!}Ve

*Automated Driving Applications and
Technologies for Intelligent Vehicles*





Conclusion

- Developing ADAS and vehicle automation, systems become complex
- Closely integrated Joint System Design is needed
- EU-Projects are addressing Joint System components, methods & tools
- Exemplary solutions show the possible developments in the future
- DLR develops Joint Systems enriched with affective HMI



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Thank You

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